

Challenges in Characterizing Low-Temperature Regolith Properties

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The success or failure of in-situ resource utilization for planetary surface exploration—be it for scientific, colonization or commercialization purposes—relies heavily on our ability to design and implement systems which effectively process the associated regolith and exploit its benefits. In most cases this challenge necessarily includes the characterization of low-temperature (cryogenic) properties; as many celestial destinations of interest, such as the moon, Mars and asteroids, have little or no atmosphere to help sustain the consistently “high” surface temperatures seen on planets such as Earth, and therefore can experience permanent cryogenic temperatures or dramatic cyclical changes. Characterization of physical properties (such as specific heat, thermal and electrical conductivity, etc.) over the entire temperature profile is undoubtedly an important piece of the puzzle; however, the impact on mechanical properties due to the introduction of icy deposits must also be explored in order to devise effective and robust excavation technologies. Currently the Granular Mechanics and Regolith Operations Lab and the Cryogenics Test Lab at NASA Kennedy Space Center are developing technologies and experimental methods to address these challenges and aid in the characterization of physical and mechanical properties of regolith at cryogenic temperatures. This presentation will review the current state of knowledge concerning lunar regolith at low temperature including that of icy regolith.